Elect

DEPARTMENT OF ELECTRICAL ENGINEERING
COLLEGE OF ENGINEERING, PUNE-05

T.Y.B.TECH ELECTRICAL

SUBJECT:-CONTROL SYSTEM-I (EE310)

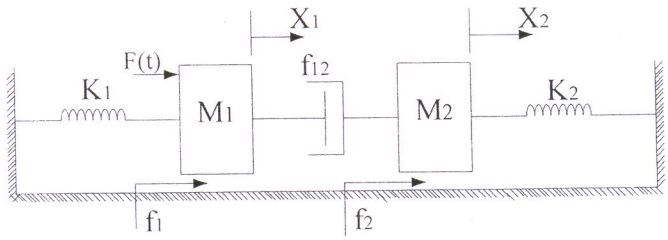
End-Semester Examination (2012-2013)

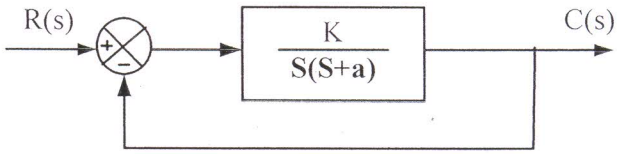
Date:-28/04/2013
Day:-Sunday

Max. Marks.-50
Time:-02.00pm to 05.00 pm

Instructions:-

1. All questions are compulsory.
2. Assume necessary data whenever required.
3. Only non programmable calculators are allowed.
4. **While writing answers maintain the sequence of questions.**
5. Draw neat diagram whenever required.

Q.N.1 A)	Write the differential equation for the mechanical system shown in figure below. Also obtain an analogous electrical circuit based on force-current analogy 	**05**
Q.N.1 B)	Certain measurements were conducted on servomechanism which show the system response as $$C(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$$ When subjected to unit step input. (a) Find the expression for the closed loop transfer function. (b) Obtain the un-damped natural frequency and damping ratio of the system.	**05**
Q.N.2 A)	The open loop transfer function of a unity feedback control system is given by $$G(s) = \frac{K}{(S+2)(S+4)(S^2+6S+25)}$$ By applying the Routh's Criterion, discuss the stability of the closed loop system as a function of K. Determine the value of K which will cause sustained oscillations in a closed loop system. What is the corresponding oscillation frequency?	**05**
Q.N.2 B)	For a control system characterised by the open loop transfer function $$G(s)H(S) = \frac{K}{S(S+2)(S+10)}$$ Sketch the Nyquist plot and hence calculate the range of values of system gain for stability	**05**

Q.N.3	Sketch the root locus plot for a control system having open loop transfer function as : $$G(s) = \frac{K}{S(S+2)(S+4)}$$ From the root locus plot determine: (a) The value of K to have 40% over shoot for unit step input. (b) The value of K that will cause sustained oscillations in output. (c) The value of K_V corresponding to the 40% over shoot for unit step input. (d) The value of settling time t_S.	**10**
Q.N.4 A)	Consider the feedback system shown in figure below (a) Find the value of 'K' and 'a' to satisfy the following frequency domain specifications: $$M_r = 1.04$$ $$\omega_r = 11.55\ rad/sec$$ (b) For the values of 'K' and 'a' determined in part (a) calculate the bandwidth of the system.  	**05**
Q.N.4 B)	Consider K=10 and obtain the Bode Plot for a unity feedback system, characterised by the open loop transfer function $$G(s) = \frac{K\,(1+0.2S)(1+0.025S)}{S^2(1+0.001S)(1+0.005S)}$$ (a) From the Bode Plot find Gain margin and Phase Margin (b) If K is doubled then what is its effect on Gain Margin and Phase Margin.	**05**
Q.N.5 A)	A system is represented by following transfer function. Express the state space model of a system in controllable canonical form, develop the state diagram and signal flow graph. $$T(s) = \frac{1}{S^2+9S+20}$$	**05**
Q.N.5 B)	The control system is described by the state model as given below $$\begin{bmatrix} \dot{x}1 \\ \dot{x}2 \\ \dot{x}3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & a \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$ $$y = [20 \quad -9 \quad 1] \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix}$$ Find the value of 'a' so that the system will be completely state controllable and observable.	**05**